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## **Arizona DEQ – Development of Acute Health-Based Ambient Air Criteria**

### **1. INTRODUCTION**

Of the total 188 Federal Hazardous Air Pollutants (HAPs) identified by EPA, approximately 75 are emitted by Arizona industries in sufficient quantities to potentially require evaluation. Part of this evaluation is to develop ambient air criteria that represent maximum concentrations based on the potential for short-term, acute health effects as a result of worst-case meteorology. The concentrations used for the acute criteria are those that most closely relate to the Arizona DEQ definition of adverse effects, which focuses on acute health effects that result in or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness, including those caused by acutely toxic substances.

The approach used to develop acute health-based ambient air criteria described below is based on a hierarchy of applicable health-based criteria. In the development of this acute health criteria hierarchy, a preference was placed on EPA's Office of Prevention, Pesticides, and Toxic Substances (OPPTS) Acute Exposure Guideline Levels (AEGLs) (Tier 1). The AEGLs are peer-reviewed, nationally recognized levels that are developed by the National Advisory Committee for Acute Exposure Guideline Levels for federal, state, and local agencies and private sector entities concerned with emergency planning, prevention, and response.

The second tier is the Emergency Response Planning Guidelines (ERPGs). ERPGs are developed by the American Industrial Hygiene Association (AIHA), a nonprofit professional organization, through a peer-review process that has been validated by other scientific agencies. ERPGs are designed to assist emergency response personnel plan for catastrophic, accidental chemical releases.

The third tier is the Temporary Emergency Exposure Limits (TEELs) developed by the Department of Energy (DOE). TEELs are typically based on a hierarchy of occupational health standards.

### **2. CRITERIA DEVELOPMENT PROCESS**

The process used to identify the most appropriate acute ambient air criteria for the compounds emitted by Arizona industries is presented below. Figure 1 shows the process as a flow chart.



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### **Tier 1 – EPA AEGL-2 Values**

AEGLs are exposure limits for the general public, including sensitive populations (e.g., infants and children), and are applicable to exposure periods ranging from 10 minutes up to 8 hours. There are 3 levels of AEGLs available (AEGL-1 through AEGL-3) that vary by degree of the severity of toxic effects. For this analysis, AEGL-2 values were used. These values represent the concentration above which it is predicted that the general population, including susceptible subpopulations, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. If an AEGL value was available, it was preferentially used.

To account for elevated concentrations of the pollutant near the maximum 1-hour average in previous or subsequent hourly averages, the AEGL-2 for a 4 hour averaging time was used. This value is slightly more conservative than the AEGL-2 for a 1 hour averaging time.

### **Tier 2 – AIHA ERPG-2 Values**

The ERPGs are developed for an exposure duration of one hour and, like the AEGLs, are developed for 3 levels that vary by degree of severity of toxic effects. For this analysis, ERPG-2 values were used. These values represent the concentration below which it is assumed that nearly all individuals could be exposed to for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action. ERPG-2 values were used for compounds that did not have an AEGL.

As described above with AEGLs, the potential exists for elevated concentrations to occur during other hours, before or after the maximum hourly average used for comparison to the criteria. To account for these other hours near the maximum 1-hour average, an adjustment was made to the ERPG-2. The adjustment selected was based on the comparison between 1-hour and 4-hour AEGLs, which is typically a factor of two or less; therefore, the ERPG-2 values (for 1 hour) were adjusted by dividing by 2.

### **Tier 3 – DOE TEEL-2 Values**

In cases where AEGLs or ERPGs were not available, TEELs were used. TEELs are developed by the DOE Emergency Management Advisory Committee's Subcommittee on Consequence Assessment and Protective Action (SCAPA) for 4 tiers that vary by degree of severity. For this analysis, the TEEL-2 values were used. These values represent the maximum concentration below which it is believed nearly all individuals could be exposed to for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.



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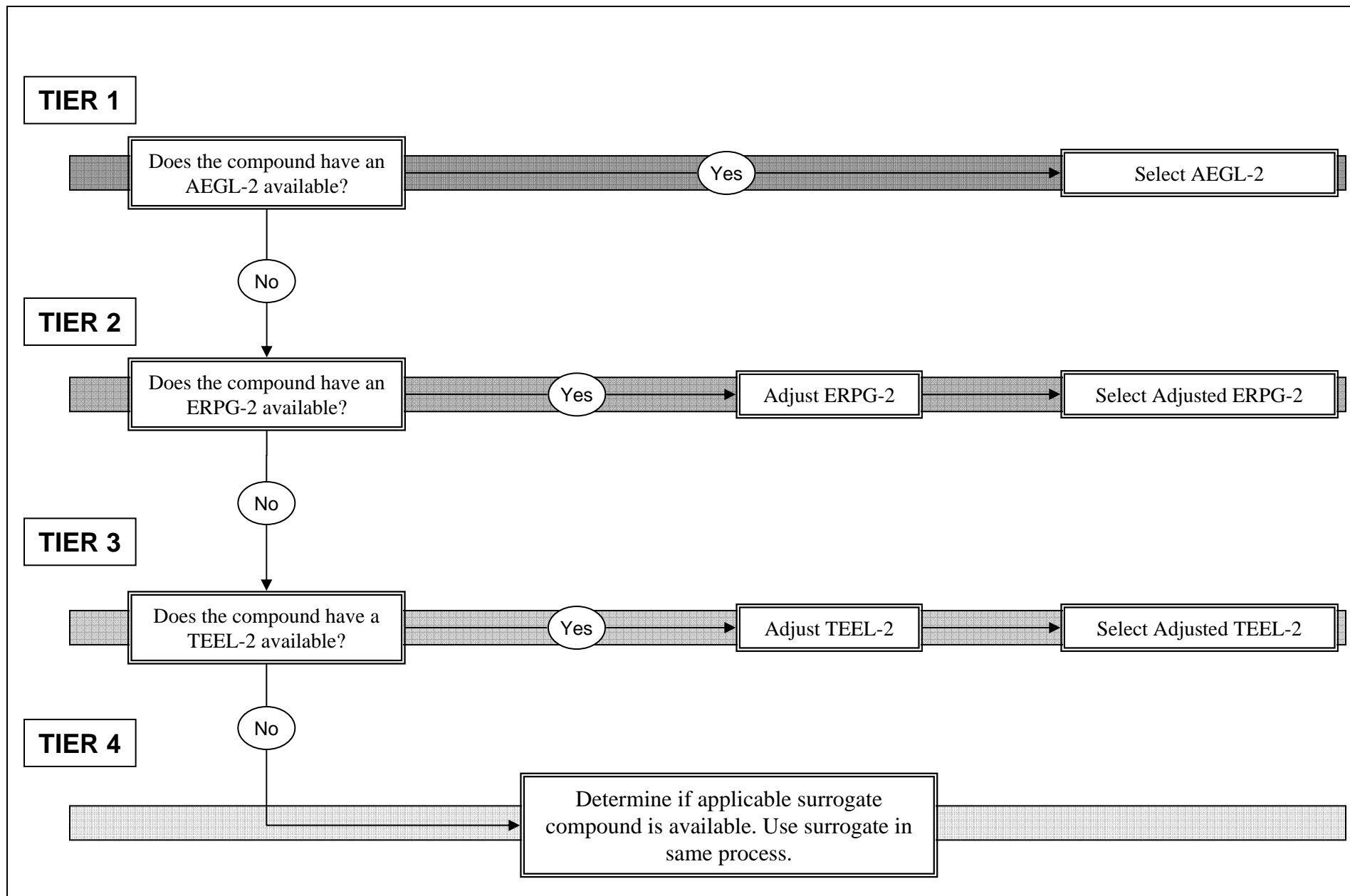
TEEL-2 values are developed based on a hierarchy of existing occupational standards (e.g., OSHA's Permissible Exposure Limits [PELs] and the National Institute for Occupational Safety and Health's [NIOSH] Immediately Dangerous to Life and Health [IDLH] levels) or, where such limits do not exist, published toxicity parameters (e.g., lowest toxic concentration [ $TC_{10}$ ] and lowest toxic dose [ $TD_{10}$ ]) using mathematical models to determine if there was a relationship between existing standards, toxicity parameters, and physical constants.

As described above with AEGLs and ERPGs, the potential exists for elevated concentrations to occur during other hours, before or after the maximum hourly average used for comparison to the criteria. To account for these other hours near the maximum 1-hour average, an adjustment was made to the TEEL-2. The adjustment selected was based on the comparison between 1-hour and 4-hour AEGLs, which is typically a factor of two or less; therefore, the TEEL-2 values (for 1 hour) were adjusted by dividing by 2.

#### **Tier 4 – No Acute Ambient Air Criteria Available**

There are several reasons why a certain compound would have no criteria available. In some cases, the identified compound is really a group of compounds. Glycol ethers and Polycyclic Organic Matter are examples of this. In these cases, a surrogate compound from the group of compounds was selected and the group of compounds was evaluated as the single compound. Since the evaluation represents a screening approach, the compound in the group with the most stringent toxicological criteria was selected. There was only one compound (2-chloroacetophenone) for which there was no data available to develop a criterion.

Table 1 presents the initial development of acute ambient air criteria. The table shows each of the available criteria in units of milligrams per cubic meter ( $mg/m^3$ ) and the applicable Tier used in the selection process. In addition, a separate table is included that provides factors to convert from  $mg/m^3$  to parts per million (ppm). Table 1 also has the previously submitted chronic values listed. This is for comparison purposes only and our intention would be to omit this from the final table.



**FIGURE 1 – Flowchart for the Selection of Acute Health-Based Ambient Air Criteria**

Table 1 - Arizona DEQ - Acute Health-Based Ambient Air Criteria Table

Chemical	Recommended Chronic Value (mg/m <sup>3</sup> )	Tier 1	Tier 2		Tier 3		Value to be Used	Notes
		AEGL-2 4 hr (mg/m <sup>3</sup> )	ERPG-2 (mg/m <sup>3</sup> )	Adjusted <sup>a</sup> ERPG-2 (mg/m <sup>3</sup> )	TEEL-2 (mg/m <sup>3</sup> )	Adjusted <sup>a</sup> TEEL-2 (mg/m <sup>3</sup> )		
Acetaldehyde	8.62E-04	306	360	180	360	180	AEGL-2/Tier 1	<sup>b</sup>
Acetophenone	3.65E-01				50	25	Adjusted TEEL-2/Tier 3	
Acrolein	2.09E-05	0.23	1	0.5	1	0.5	AEGL-2/Tier 1	<sup>c</sup>
Acrylonitrile	2.79E-05		76	38	76	38	Adjusted ERPG-2/Tier 2	
Antimony Compounds	1.46E-03				25	12.5	Adjusted TEEL-2/Tier 3	
Arsenic Compounds	4.41E-07				5	2.5	Adjusted TEEL-2/Tier 3	
Benzene	2.43E-04	1276	470	235	470	235	AEGL-2/Tier 1	<sup>b</sup>
Benzyl Chloride	3.96E-05		52	26	52	26	Adjusted ERPG-2/Tier 2	
Beryllium Compounds	7.90E-07		0.025	0.0125	0.025	0.0125	Adjusted ERPG-2/Tier 2	
Biphenyl	1.83E-01	38			6.5	3.3	AEGL-2/Tier 1	<sup>b</sup>
bis(2-Ethylhexyl) Phthalate	4.80E-04				25	12.5	Adjusted TEEL-2/Tier 3	
Bromoform	1.72E-03				15	7.5	Adjusted TEEL-2/Tier 3	
1,3-Butadiene	6.32E-05	7514	440	220	440	220	AEGL-2/Tier 1	<sup>b</sup>
Cadmium Compounds	1.05E-06				0.5	0.25	Adjusted TEEL-2/Tier 3	
Carbon Disulfide	7.30E-01	311	155	78	155	78	AEGL-2/Tier 1	<sup>c</sup>
Carbon Tetrachloride	1.26E-04	201	639	319.5	639	319.5	AEGL-2/Tier 1	<sup>c</sup>
Carbonyl Sulfide	NA				60	30	Adjusted TEEL-2/Tier 3	
2-Chloroacetophenone	3.13E-05						NA	
Chlorobenzene	1.04E+00				2000	1000	Adjusted TEEL-2/Tier 3	
Chloroform	3.58E-04	195	248	124	248	124	AEGL-2/Tier 1	<sup>c</sup>
Chromium Compounds	1.58E-07				0.2	0.100	Adjusted TEEL-2/Tier 3	<sup>d</sup>
Cobalt Compounds	6.86E-07				20	10.0	Adjusted TEEL-2/Tier 3	
Cumene	4.17E-01	935			250	125	AEGL-2/Tier 1	<sup>b</sup>
Cyanide Compounds	3.13E-03	3.9			5	2.5	AEGL-2/Tier 1	<sup>e, f</sup>
Dibenzofurans	7.30E-03				50	25	Adjusted TEEL-2/Tier 3	
1,4-Dichlorobenzene	3.06E-04				600	300	Adjusted TEEL-2/Tier 3	
Dichloromethane (Methylene Chloride)	4.03E-03	347	2610	1305	2610	1305	AEGL-2/Tier 1	<sup>b</sup>
N, N-Dimethylaniline	7.30E-03				50	25	Adjusted TEEL-2/Tier 3	
Dimethyl Formamide	3.13E-02	164	299	150	299	150	AEGL-2/Tier 1	<sup>c</sup>
Dimethyl Sulfate	NA	0.31			5	2.5	AEGL-2/Tier 1	<sup>b</sup>
2,4-Dinitrotoluene	2.13E-05				10	5.0	Adjusted TEEL-2/Tier 3	
Ethyl Benzene	1.04E+00				500	250	Adjusted TEEL-2/Tier 3	
Ethyl Chloride (Chloroethane)	1.04E+01				2500	1250	Adjusted TEEL-2/Tier 3	
Ethylene Dibromide (Dibromoethane)	3.16E-06				200	100	Adjusted TEEL-2/Tier 3	
Ethylene Dichloride (1,2-Dichloroethane)	7.29E-05		810	405	810	405	Adjusted ERPG-2/Tier 2	
Ethylene Glycol	4.17E-01				100	50	Adjusted TEEL-2/Tier 3	
Ethylidene Dichloride (1,1-Dichloroethane)	5.21E-01				12500	6250	Adjusted TEEL-2/Tier 3	
Formaldehyde	1.46E-04	17	12.5	6.3	12.5	6.3	AEGL-2/Tier 1	<sup>b</sup>
Glycol Ethers (Surrogate - Diethylene glycol, monobutyl ether)	3.14E-03				500	250	Adjusted TEEL-2/Tier 3	
Hexachlorobenzene	4.12E-06				1	0.5	Adjusted TEEL-2/Tier 3	
Hexane	2.21E+00	11649			750	375	AEGL-2/Tier 1	<sup>b</sup>
Hydrochloric Acid	2.09E-02	16	30	15	30	15	AEGL-2/Tier 1	<sup>e</sup>
Hydrogen Fluoride (Hydrofluoric Acid)	1.46E-02	10	16.4	8.2	16.4	8.2	AEGL-2/Tier 1	<sup>e</sup>
Isophorone	2.09E+00				25	12.5	Adjusted TEEL-2/Tier 3	
Manganese Compounds	5.21E-05				5	2.5	Adjusted TEEL-2/Tier 3	
Mercury Compounds	3.13E-04		2.05	1.025	2.05	1.03	Adjusted ERPG-2/Tier 2	
Methanol	4.17E+00	943	1308	654	1308	654	AEGL-2/Tier 1	<sup>c</sup>
Methyl Bromide	5.21E-03	261	195	97.5	195	97.5	AEGL-2/Tier 1	<sup>b</sup>
Methyl Chloride	9.39E-02	1180	828	414	828	414	AEGL-2/Tier 1	<sup>b</sup>
Methyl Ethyl Ketone	5.21E+00	5015			750	375	AEGL-2/Tier 1	<sup>c</sup>
Methyl Isobutyl Ketone (Hexone)	3.13E+00				1000	500	Adjusted TEEL-2/Tier 3	
Methyl Methacrylate	7.30E-01	311			400	200	AEGL-2/Tier 1	<sup>b</sup>

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Methyl Tert-Butyl Ether	7.40E-03	1444			750	375	AEGL-2/Tier 1	<sup>b</sup>
Methylhydrazine	3.96E-07	0.43			0.94	0.47	AEGL-2/Tier 1	<sup>e</sup>
Naphthalene	5.58E-05				150	75	Adjusted TEEL-2/Tier 3	
Nickel Compounds	7.90E-06				10	5.0	Adjusted TEEL-2/Tier 3	
Phenol	2.09E-01	58	200	100	200	100	AEGL-2/Tier 1	<sup>c</sup>
Polychlorinated Biphenyls	1.90E-05				5	2.5	Adjusted TEEL-2/Tier 3	
Polycyclic Organic Matter (Surrogate - Benzo(a)pyrene)	2.02E-06				10	5.0	Adjusted TEEL-2/Tier 3	
Propionaldehyde	8.62E-04	403			500	250	AEGL-2/Tier 1	<sup>b</sup>
Propylene Dichloride	4.17E-03				500	250	Adjusted TEEL-2/Tier 3	
Selenium Compounds	1.83E-02				1	0.5	Adjusted TEEL-2/Tier 3	
Styrene	1.04E+00	554	1065	532.5	1065	532.5	AEGL-2/Tier 1	<sup>b</sup>
1,1,2,2-Tetrachloroethane	3.27E-05				35	18	Adjusted TEEL-2/Tier 3	
Tetrachloroethylene (Perchloroethylene)	3.20E-04	814	1378	689	1378	689	AEGL-2/Tier 1	<sup>c</sup>
Toluene	4.17E-01	1923	1125	562.5	1125	562.5	AEGL-2/Tier 1	<sup>c</sup>
1,1,1-Trichloroethane (Methyl Chloroform)	2.30E+00	2075	3850	1925	3850	1925	AEGL-2/Tier 1	<sup>c</sup>
Trichloroethylene	1.68E-05	1450	2690	1345	2690	1345	AEGL-2/Tier 1	<sup>c</sup>
2,2,4-Trimethylpentane	NA				1800	900	Adjusted TEEL-2/Tier 3	
Vinyl Acetate	2.09E-01	387	264	132	264	132	AEGL-2/Tier 1	<sup>b</sup>
Vinyl Chloride	2.15E-04	2099	13000	6500	13000	6500	AEGL-2/Tier 1	<sup>b</sup>
Vinylidene Chloride (1,1-Dichloroethylene)	2.09E-01				75	38	Adjusted TEEL-2/Tier 3	
Xylene (Mixed Isomers)	1.04E-01	1736			750	375	AEGL-2/Tier 1	<sup>c</sup>

NA = Not available.

<sup>a</sup> The ERPG-2 and TEEL-2 values were adjusted by dividing by 2.<sup>b</sup> AEGL is a "Proposed" value.<sup>c</sup> AEGL is an "Interim" value.<sup>d</sup> Based on Chromium VI.<sup>e</sup> AEGL is a "Final" value.<sup>f</sup> The AEGL is based on hydrogen cyanide. The TEEL is based on cyanide.